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MATERIALS TECHNOLOGY DEPARTMENT

# SOLAR ENERGY COLLECTOR *

by

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National Aeronautics and Space Administration
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## Introduction

This report is the fourth monthly report on Contract NAS 1-3244, Rigidized Solar Energy Collectors. (The third month's progress was reported as a quarterly, not a monthly report.) In the preceding report details were given of the "lock" fabric system of adhering the polyester rigidizing layer to the gel coat. The gel coats used were several types of polysulfides, made by three different manufacturers. During the past month additional work was done with these gel coats to try to reduce the weight required. Gel coats utilizing epoxy-polysulfide mixtures and epoxy-polyamide mixtures were also tested with no marked improvements.

## Gel Coat Investigations

In the previous month several polysulfide gel coat materials were tested on small 6 inch diameter fixtures to get a preliminary idea of their effectiveness. The materials all seemed approximately equal in their performance. The materials tested were as follows:

1. CS-3414 Chem-Seal Corporation
2. 890B Coast Pro-Seal Products
3. EC-801 Minn. Mining & Mfg. Co.
4. EC-1239 Minn. Mining & Mfg. Co.

Each of the polysulfides appeared to have good adhesion to the Mylar and to show good flexibility when cured. Polyester adhesion to the polysulfide coating, however was uniformly poor, unless the fabric lock coat was used. The polysulfide coating selected for further tests was EC-801 made by Minnesota Mining and Mfg. Company.

Since the polysulfides were still not entirely satisfactory from the standpoint of adhesion to the polyester layer several epoxy-polyamide mixtures were also tested. The mixtures consisted of 30 parts Union Carbide ERL 2795 epoxy resin and 70 parts of General Mills Versamid 125 and 5 parts of Cabosil as a thixotropic agent. Fair to good adhesion to the Mylar was achieved and fair adhesion to the polyester resulted. The final optics, however, in each case were poor. The surface, while not showing a fabric pattern showed a fine "orange peel" effect. A 50-50 versamid-epoxy mixture was somewhat less flexible than the 70-30 mixture, but did show a finer "orange peel" surface.

Mixtures made using Thiokol LP-3 monomer and Epon 828 epoxy were also tested, with results very similar to the Versamid-epoxy samples, i.e., poor optics when the polyester resin gelled.

Storage Tests

Since, in service, the collector would have to be stored for a finite period of time, with the gel coat cured and an uncured rigidizing coat, such a preliminary test was made. A 24 inch diameter specimen was coated on one half the surface with Pro-Seal 890 and the other half with an epoxy-Versamid coating, and a "lock" fabric was applied over all but approximately one third of the epoxy coated surface. The sample was rolled up for 72 hours. On unrolling and repressurizing the diaphragm permanent wrinkles were found throughout the lock fabric. These wrinkles persisted after the polyester rigidizing layer was applied. The epoxy-Versamid coated section showed no wrinkles and had good adhesion.

Mylar Surface Treatments

The above tests, indicated that the use of the "lock" fabric might be detrimental. Therefore a series of tests were initiated to attempt to etch the Mylar surface in order to improve the gel coat-to-Mylar bond. It was found that a 75 to 95% sulfuric acid solution swabbed on the Mylar surface for 20-30 minutes at room temperature would definitely etch the surface. Somewhat the same results could be obtained using fine emery paper. The first adhesion tests made showed inconsistent results, so more tests are being run.

Purchased Parts

The three five-foot diameter Mylar mosaic diaphragms have been received from the G. T. Schjeldahl Company and also one completely fabricated assembly. The three diaphragms all had badly wrinkled and marked up surfaces as the result of mishandling during fabrication by Schjeldahl. The complete assembly had a somewhat better surface appearance.

Tooling

The five foot test fixture has been completed and has been used to pressure test one mosaic. Several points of poor seam adhesion were found and one actual leak. It was, however, possible to determine the pressures required for the stress relaxation process.

The two foot fixture has also been built. This is an all acrylic fixture similar to the six inch fixtures. With this tool it is possible to lay up parts and observe exactly at what point distortion sets in.

Future Plans

Improvement of optics still appears to be the major problem. Some of the techniques to be tried are as follows:

1. Tests will be made of various polyesters to attempt to obtain material with the lowest shrinkage.

2. Efforts will be made to eliminate the use of the "lock" fabric.

3. Efforts will be made to utilize the epoxy-Versamid mixtures which should inherently be better for space applications than the polysulfides.

4. Preliminary tests will be started on the five foot mosaic assemblies.

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